1. POPIS

Tento shield je kompatibilní s vývojovými kity Raspberry Pi B+/B.

Základní charakteristika:
- displej typu 1602 (16 znaků, 2 řádky)
- 3x indikační LED
- 5x tlačítko
- 7 volitelných barev podsvícení
- Potenciometr pro nastavení jasu
- Komunikace přes rozhraní I²C

2. SPECIFIKACE

<table>
<thead>
<tr>
<th></th>
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<th>Počet znaků</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Napájecí napětí</strong></td>
<td>5 VDC</td>
<td></td>
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<tr>
<td><strong>Max. proud</strong></td>
<td>60 mA</td>
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<tr>
<td><strong>Komunikační rozhraní</strong></td>
<td>I²C</td>
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<tr>
<td><strong>Kompatibilita HW</strong></td>
<td>Raspberry Pi B+/B</td>
<td></td>
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<tr>
<td><strong>Kompatibilita SW</strong></td>
<td>Raspbian a podobné</td>
<td></td>
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<tr>
<td><strong>Typ displeje</strong></td>
<td>negativní LCD</td>
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<tr>
<td><strong>Rozměry (mm)</strong></td>
<td>82 x 58</td>
<td></td>
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<tr>
<td><strong>Provozní teplota (°C)</strong></td>
<td>0 až 50</td>
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<tr>
<td><strong>Hmotnost (g)</strong></td>
<td>102</td>
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</tbody>
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3. ZAPOJENÍ

Tento shield nevyžaduje žádné externí zapojení, pouze vsuňte modul do vývojového kitu Raspberry.
4. UKÁZKA PROGRAMU

Ukázka převzata z https://github.com/adafruit/Adafruit_Python_CharLCD.

```python
# Copyright (c) 2014 Adafruit Industries
# Author: Tony DiCola
#
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# THE SOFTWARE.

import time
import Adafruit_GPIO as GPIO
import Adafruit_GPIO.I2C as I2C
import Adafruit_GPIO.MCP230xx as MCP
import Adafruit_GPIO.PWM as PWM

# Commands
LCD_CLEARDISPLAY = 0x01
LCD_RETURNHOME = 0x02
LCD_ENTRYMODESET = 0x04
LCD_DISPLAYCONTROL = 0x08
LCD_CURSORSHIFT = 0x10
LCD_FUNCTIONSET = 0x20
LCD_SETCGRAMADDR = 0x40
LCD_SETDDRAMADDR = 0x80

# Entry flags
LCD_ENTRYRIGHT = 0x00
LCD_ENTRYLEFT = 0x02
LCD_ENTRYSHIFTINCREMENT = 0x01
LCD_ENTRYSHIFTDECREMENT = 0x00

# Control flags
LCD_DISPLAYON = 0x04
LCD_DISPLAYOFF = 0x00
LCD_CURSORON = 0x02
LCD_CURSOROFF = 0x00
LCD_BLINKON = 0x01
LCD_BLINKOFF = 0x00

# Move flags
LCD_DISPLAYMOVE = 0x08
LCD_CURSORMOVE = 0x00
LCD_MOVELEFT = 0x00

# Function set flags
LCD_8BITMODE = 0x10
LCD_4BITMODE = 0x00
LCD_2LINE = 0x08
LCD_1LINE = 0x00
LCD_5x10DOTS = 0x04
LCD_5x8DOTS = 0x00

# Offset for up to 4 rows.
```

```
LCD_ROW_OFFSETS = (0x00, 0x40, 0x14, 0x54)

# Char LCD plate GPIO numbers.
LCD_PLATE_RS  =  15
LCD_PLATE_RW  =  14
LCD_PLATE_EN  =  13
LCD_PLATE_D4  =  12
LCD_PLATE_D5  =  11
LCD_PLATE_D6  =  10
LCD_PLATE_D7  =   9
LCD_PLATE_RED =   6
LCD_PLATE_GREEN =   7
LCD_PLATE_BLUE =   8

# Char LCD plate button names.
SELECT  =   0
RIGHT  =   1
DOWN  =   2
UP  =   3
LEFT  =   4

class Adafruit_CharLCD(object):
    """Class to represent and interact with an HD44780 character LCD display."""
    def __init__(self, rs, en, d4, d5, d6, d7, cols, lines, backlight=None,
                 invert_polarity=True, enable_pwm=False,
                 gpio=GPIO.get_platform_gpio(),
                 pwm=PWM.get_platform_pwm(),
                 initial_backlight=1.0):
        """Initialize the LCD. RS, EN, and D4...D7 parameters should be the pins connected to the LCD RS, clock enable, and data line 4 through 7 connections. The LCD will be used in its 4-bit mode so these 6 lines are the only ones required to use the LCD. You must also pass in the number of columns and lines on the LCD.

        If you would like to control the backlight, pass in the pin connected to the LCD RS, clock enable, and data line 4 through 7 connections. The LCD will be used in its 4-bit mode so these 6 lines are the only ones required to use the LCD. You must also pass in the number of columns and lines on the LCD.

        If you would like to control the backlight, pass in the pin connected to the backlight with the backlight parameter. The invert_polarity boolean controls if the backlight is on with a LOW signal or HIGH signal. The default invert_polarity value is True, i.e. the backlight is on with a LOW signal.

        You can enable PWM of the backlight pin to have finer control on the brightness. To enable PWM make sure your hardware supports PWM on the provided backlight pin and set enable_pwm to True (the default is False). The appropriate PWM library will be used depending on the platform, but you can provide an explicit one with the pwm parameter.

        The initial state of the backlight is ON, but you can set it to an explicit initial state with the initial_backlight parameter (0 is off, 1 is on/full bright).

        You can optionally pass in an explicit GPIO class, for example if you want to use an MCP230xx GPIO extender. If you don’t pass in an GPIO instance, the default GPIO for the running platform will be used.
        """
        self._cols = cols
        self._lines = lines
        self._gpio = gpio
        self._rs = rs
        self._en = en
        self._d4 = d4
        self._d5 = d5
        self._d6 = d6
        self._d7 = d7
        self._backlight = backlight
        self._pwm_enabled = enable_pwm
        self._pwm = pwm
        self._blpol = not invert_polarity
```

# Setup all pins as outputs.
for pin in (rs, en, d4, d5, d6, d7):
gpio.setup(pin, GPIO.OUT)

# Setup backlight.
if backlight is not None:
    if enable_pwm:
        pwm.start(backlight, self._pwm_duty_cycle(initial_backlight))
    else:
        gpio.setup(backlight, GPIO.OUT)
        gpio.output(backlight, self._blpol if initial_backlight else not self._blpol)

# Initialize the display.
self.write8(0x33)
sel.write8(0x32)

self.displaycontrol = LCD_DISPLAYON | LCD_CURSOROFF | LCD_BLINKOFF
self.displayfunction = LCD_4BITMODE | LCD_1LINE | LCD_2LINE | LCD_5x8DOTS
self.displaymode = LCD_ENTRYLEFT | LCD_ENTRYSHIFTDECREMENT

# Write registers.
self.write8(LCDisplayCONTROL | self.displaycontrol)
sel.write8(LCD_FUNCTIONSET | self.displayfunction)
sel.write8(LCD_ENTRYMODESET | self.displaymode)  # set the entry mode
self.clear()

def home(self):
    """Move the cursor back to its home (first line and first column)."""
    self.write8(LCD_RETURNHOME)  # set cursor position to zero
    self._delay_microseconds(3000)  # this command takes a long time!

def clear(self):
    """Clear the LCD."""
    self.write8(LCD_CLEARDISPLAY)  # command to clear display
    self._delay_microseconds(3000)  # 3000 microsecond sleep, clearing the display takes a long time

def set_cursor(self, col, row):
    """Move the cursor to an explicit column and row position."""
    # Clamp row to the last row of the display.
    if row > self._lines:
        row = self._lines - 1
    # Set location.
    self.write8(LCD_SETDDRAMADDR | (col + LCD_ROW_OFFSETS[row]))

def enable_display(self, enable):
    """Enable or disable the display. Set enable to True to enable."""
    if enable:
        self.displaycontrol |= LCD_DISPLAYON
    else:
        self.displaycontrol &= ~LCD_DISPLAYON
    self.write8(LCDisplayCONTROL | self.displaycontrol)

def show_cursor(self, show):
    """Show or hide the cursor. Cursor is shown if show is True."""
    if show:
        self.displaycontrol |= LCD_CURSORON
    else:
        self.displaycontrol &= ~LCD_CURSORON
    self.write8(LCD_DISPLAYCONTROL | self.displaycontrol)

def blink(self, blink):
    """Turn on or off cursor blinking. Set blink to True to enable blinking."""
    if blink:
        self.displaycontrol |= LCD_BLINKON
    else:
        self.displaycontrol &= ~LCD_BLINKON
    self.write8(LCD_DISPLAYCONTROL | self.displaycontrol)

def move_left(self):
    """Move display left one position."""
    self.write8(LCD_CURSORSHIFT | LCD_DISPLAYMOVE | LCD_MOVELEFT)

def move_right(self):
    """Move display right one position."""
def set_left_to_right(self):
    """Set text direction left to right."""
    self.displaymode &= LCD_ENTRYLEFT
    self.write8(LCD_ENTRYMODESET | self.displaymode)

def set_right_to_left(self):
    """Set text direction right to left."""
    self.displaymode ^= -LCD_ENTRYLEFT
    self.write8(LCD_ENTRYMODESET | self.displaymode)

def autoscroll(self, autoscroll):
    """Autoscroll will 'right justify' text from the cursor if set True,
    otherwise it will 'left justify' the text.
    """
    if autoscroll:
        self.displaymode |= LCD_ENTRYSHIFTINCREMENT
    else:
        self.displaymode &= ~LCD_ENTRYSHIFTINCREMENT
    self.write8(LCD_ENTRYMODESET | self.displaymode)

def message(self, text):
    """Write text to display. Note that text can include newlines.""
    line = 0
    # Iterate through each character.
    for char in text:
        # Advance to next line if character is a new line.
        if char == '\n':
            line += 1
        # Move to left or right side depending on text direction.
        col = 0
        if self.displaymode & LCD_ENTRYLEFT > 0
            self.set_cursor(col, line)
        # Write the character to the display.
        else:
            self.write8(ord(char), True)

def set_backlight(self, backlight):
    """Enable or disable the backlight. If PWM is not enabled (default), a
    non-zero backlight value will turn on the backlight and a zero value
    will turn it off. If PWM is enabled, backlight can be any value from 0.0 to
    1.0, with 1.0 being full intensity backlight.
    ""
    if self.backlight is None:
        if self.pwm_enabled:
            self.pwm.set_duty_cycle(self.backlight, self.pwm_duty_cycle(backlight))
        else:
            self.backlight = _pwm_enabled

def write8(self, value, char_mode=False):
    """Write 8-bit value in character or data mode. Value should be an int
    value from 0-255, and char_mode is True if character data or False if
    non-character data (default).
    ""
    # One millisecond delay to prevent writing too quickly.
    self._delay_microseconds(1000)
    # Set character / data bit.
    self._gpio.output(self._rs, char_mode)
    # Write upper 4 bits.
    self._gpio.output_pins(self._d4, ((value >> 4) & 1) > 0,
                               self._d5, ((value >> 5) & 1) > 0,
                               self._d6, ((value >> 6) & 1) > 0,
                               self._d7, ((value >> 7) & 1) > 0)
    self._pulse_enable()
    # Write lower 4 bits.
    self._gpio.output_pins(self._d4, (value & 1) > 0,
                               self._d5, (value & 1) > 0,
                               self._d6, (value & 2) > 0,
                               self._d7, (value & 3) > 0)
    self._pulse_enable()

def create_char(self, location, pattern):
    """Fill one of the first 8 CGRAM locations with custom characters.
    The location parameter should be between 0 and 7 and pattern should
    provide an array of 8 bytes containing the pattern. E.g. you can easily
design your custom character at http://www.quinnsalus.com/hd44780udg.html
To show your custom character use eg. lcd.message(\"x01\")

```python
def __init__(self, rs, en, d4, d5, d6, d7, cols, lines, red, green, blue,
            gpio=GPI0.get_platform_gpio(),
            invert_polarity=True,
            enable_pwm=False,
            pwm=PWM.get_platform_pwm(),
            initial_color=(1.0, 1.0, 1.0)):

    """Initialize the LCD with RGB backlight. RS, EN, and D4...D7 parameters
    should be the pins connected to the LCD RS, clock enable, and data line
    4 through 7 connections. The LCD will be used in its 4-bit mode so these
    6 lines are the only ones required to use the LCD. You must also pass in
    the number of columns and lines on the LCD.

    The red, green, and blue parameters define the pins which are connected
to the appropriate backlight LEDs. The invert_polarity parameter is a
boolean that controls if the LEDs are on with a LOW or HIGH signal. By default
invert_polarity is True, i.e. the backlight LEDs are on with a low
signal. If you want to enable PWM on the backlight LEDs (for finer
control of colors) and the hardware supports PWM on the provided pins,
set enable_pwm to True. Finally you can set an explicit initial backlight
color with the initial_color parameter. The default initial color is
white (all LEDs lit).

    You can optionally pass in an explicit GPIO class,
    for example if you want to use an MCP230xx GPIO extender. If you don't
    pass in an GPIO instance, the default GPIO for the running platform will
    be used.

    super(Adafruit_RGBCharLCD, self).__init__ (rs, en, d4, d5, d6, d7,
        cols,
        lines,
        enable_pwm=enable_pwm,
        backlight=none,
        invert_polarity=invert_polarity,
        gpio=gpio,
        pwm=pwm)

    self._red = red
```
class Adafruit_CharLCDPlate(Adafruit_RGBCharLCD):
    
    def set_backlight(self, backlight):
        
        # Setup backlight pins
        if enable_pwm:
            # Determine initial backlight duty cycles.
            rdc, gdc, bdc = self._rgb_to_duty_cycle(initial_color)
            self._rgb_to_duty_cycle(red, rdc)
            self._rgb_to_duty_cycle(green, gdc)
            self._rgb_to_duty_cycle(blue, bdc)
        else:
            gpio.setup(red, GPIO.OUT)
            gpio.setup(green, GPIO.OUT)
            gpio.setup(blue, GPIO.OUT)
            self._rgb_to_duty_cycle(red, rdc)
            self._rgb_to_duty_cycle(green, gdc)
            self._rgb_to_duty_cycle(blue, bdc)

    def _rgb_to_duty_cycle(self, rgb):
        return {self._red: self._blpol if red else not self._blpol,
                self._green: self._blpol if green else not self._blpol,
                self._blue: self._blpol if blue else not self._blpol }

def set_backlight(self, backlight):
    
    # Setup appropriate backlight pins based on polarity and enabled colors.
    self._gpio.output_pins({self._red: self._blpol if red else not self._blpol,
                            self._green: self._blpol if green else not self._blpol,
                            self._blue: self._blpol if blue else not self._blpol })

    # Set duty cycle of PWM pins.
    rdc, gdc, bdc = self._rgb_to_duty_cycle((red, green, blue))
    self._rgb_to_duty_cycle(red, rdc)
    self._rgb_to_duty_cycle(green, gdc)
    self._rgb_to_duty_cycle(blue, bdc)

    def set_color(self, red, green, blue):
        
        # Convert tuple of RGB 0-1 values to tuple of duty cycles (0-100).
        red, green, blue = rgb
        
        # Clamp colors between 0.0 and 1.0
        red = max(0.0, min(1.0, red))
        green = max(0.0, min(1.0, green))
        blue = max(0.0, min(1.0, blue))

        return (self._rgb_to_duty_cycle(red),
                self._rgb_to_duty_cycle(green),
                self._rgb_to_duty_cycle(blue))

    def _rgb_to_duty_cycle(self, rgb):
        return (red, green, blue)

    def _rgb_to_pins(self, rgb):
        self._red = red
        self._green = green
        self._blue = blue
# Set LCD R/W pin to low for writing only.
self._mcp.setup(LCD_PLATE_RW, GPIO.OUT)
self._mcp.output(LCD_PLATE_RW, GPIO.LOW)

# Set buttons as inputs with pull-ups enabled.
for button in (SELECT, RIGHT, DOWN, UP, LEFT):
    self._mcp.setup(button, GPIO.IN)
    self._mcp.pullup(button, True)

# Initialize LCD (with no PWM support).
super(Adafruit_CharLCDPlate, self).init((LCD_PLATE_RS, LCD_PLATE_EN,
    LCD_PLATE_D4, LCD_PLATE_D5, LCD_PLATE_D6, LCD_PLATE_D7, cols, lines,
    LCD_PLATE_RED, LCD_PLATE_GREEN, LCD_PLATE_BLUE, enable_pwm=False,
    gpio=self._mcp)

def is_pressed(self, button):
    """Return True if the provided button is pressed, False otherwise."""
    if button not in set((SELECT, RIGHT, DOWN, UP, LEFT)):
        raise ValueError('Unknown button, must be SELECT, RIGHT, DOWN, UP, or LEFT."
    return self._mcp.input(button) == GPIO.LOW